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CHAPTER 4

GEOMETRIC DESIGN FOR WALKS AND OPEN STORAGE AREAS

4-1. Walks.

a. Need. Walks and walkways could be non-essential items during an emergency situation and hence, should not be considered unless deemed necessary or circumstances allow for their construction.

b. Criteria. Smooth, hard-surface walks should be provided to accommodate pedestrian traffic. However, gravel, stone slab, wood or other type walk materials could be utilized if they are readily available.

c. Geometric design. Safety and volume of pedestrian traffic are the primary controls for geometric design of walks. A design pedestrian traffic volume (pedestrians per hour) must be estimated on the basis of available data, engineering judgment, and pedestrian traffic at existing similar installations.

d. Width. The minimum width for walks at Army installations will be 3 feet. Walks will normally be in increments of 2 feet (width of pedestrian traffic lane) as required to accommodate the anticipated volume of pedestrian traffic. An extra foot of width should be added to walks adjacent to curbs or where obstacles encroach on the walk. Width of walks will be determined on the basis of the capacities (pedestrians per hour) shown in the following tabulation:

<u>Capacity of Walks in Pedestrians per Hour</u>	<u>Minimum Width, ft</u>
Less than 10	3
Up to 100	4
100 to 750	6
100 to 1,000	6
Greater than 750	8
Greater than 1,000	10

e. Grade. The grade of walks should follow the natural grade of the ground as nearly as possible. The transverse grade will not be less than 1/4 in/ft. The longitudinal grade should not be greater than about 15 percent. Steps will be used where the maximum longitudinal slope would otherwise be too great. Steps should be grouped together, rather than spaced as individual steps, and located so that they will be lighted by adjacent street or night lights. The sum of the depth of tread and height of riser should not be less than 18 inches and risers should not be less than 5 inches or greater than 7 inches on any steps.

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4-2. Open storage areas and parking.

a. General. This section deals with geometric design criteria for parking lots, motor pools, organizational motor parks, material storage areas, utility yards, and miscellaneous repair yards. Storage of explosives or fuels require special conditions and are not included in open storage.

b. Parking lots, motor pools, and repair areas. Traffic volume and mix are the primary considerations in the selection of type of surfacing. It is essential to determine the number of vehicle passes and the traffic patterns of the various types of vehicles under consideration. Special consideration should be given to pavements subject to repeated traffic of track-type vehicles or where fuel and lubricant spillage may occur. The minimum traffic volumes considered for parking lots, motor pools, or repair areas should be equivalent to Class E streets (See table 1-2). Where applicable, design criteria of state or local regulatory agencies may be utilized. Where massive parking is necessary, cross traffic connections should be provided at about 360 foot (40 stalls) intervals. Islands or medians may not be practical under mobilization conditions, however wooden barriers (power poles), railroad ties, or precast concrete bumpers can be used to organize and control traffic and to protect adjoining areas at edge of pavements. Minimum grades should be provided to allow drainage of the areas. Natural drainage to the perimeter of the paved area is preferred; inlets for drainage within the paved area will be avoided to the greatest extent possible. A maximum slope of 5 percent may be used in parking lots, motor pools, and repair areas without restriction of traffic direction or parking angle.

c. Material storage areas. Suitable areas for the storage of goods and materials that do not require extensive protection from the elements will be required at nearly all types of Army installations. In general, these areas will be of an improved type with the area graded to allow good drainage, the subgrade and base course prepared, and a hard surface provided. Semi-improved areas where no hard surface is included may be used under special conditions; however, reduced bearing capacity and potential material handling equipment problems will restrict the use of this type of area. Unimproved areas where no grading for drainage or hard surfaces are provided may be acceptable for materials during construction but should not be considered as Army installation open storage.

(1) Shipping and receiving. A space for loading and unloading will be provided the extent of which will be a function of volume of materials handled and the method of delivery. Minimum provisions will be space for a tractor-trailer to be unloaded by a fork lift truck. Where a railroad siding is included or where high volumes of truck deliveries are anticipated, rail siding platforms will be provided.

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(2) Arrangement of storage. Detailed arrangement of storage areas will be a function of type and volume of material, storage time per item, material handling equipment used, and storage inventory procedures. In general though, efficient layouts provide for straight-line flow of material from loading/unloading areas to storage, ready access to each material storage location and efficient use of aisles. Aisles will essentially be roads and should be designed as such for dimensions and traffic flow.

(3) Lines and grades. Storage areas will have minimum slopes consistent with good drainage. Area drains and inlets within the limits of the pavement will be avoided to the greatest extent possible. Surface smoothness on hard surface pavements, will not exceed $3/8$ inch deviation from a straightedge laid diagonally across the space of a single storage element (pallet, drum, packing crate, etc.). Where semi-improved storage areas are provided, the deviation from a straightedge should not exceed $5/8$ inch. The difference in elevation of the highest and the lowest point of any single storage space (based on a 4 foot square pallet) should not exceed $1-1/2$ inches when materials are stacked 15 feet or higher, nor should the slope of the overall storage area exceed 3 percent grade. Where material is stacked less than 15 feet high, a single space differential of $2-1/2$ inches and an overall slope of 5 percent grade may be permitted. The use of containerized storage for Army installations other than ports or depots is expected to be limited. See EM 1110-3-150 for special requirements of container handling and storage if required.

(4) Selection of hard surface pavements. The factors that affect the surfacing requirements of improved open storage areas include vehicle characteristics, traffic volume and flow patterns, material accessibility, and weight requirements of the stored material. There are two types of surfaces that are frequently used on improved storage areas: flexible pavements (EM 1110-3-131) and rigid pavements (EM 1110-3-132). Rigid pavement applications are better suited in areas where temperature fluctuations are extreme; however they are labor intensive with longer construction times and are generally more expensive. Flexible pavements are more commonly used but may be limited by material availability. Steel mat may be selected for short term use as an expedient surfacing method. Minimum design considerations should be based on traffic flows for Class E streets (see table 1-2) and/or a minimum static load from material of 1,500 psf. The use of both rigid and flexible pavements may be considered, such as flexible pavement for storage and concrete for aisles and special areas; however, design and construction time constraints as well as material availability must be considered.

(5) Lighting. General area lighting of $1/2$ foot-candle at ground level uniformly distributed over the entire storage area should be considered the minimum lighting level. Additional lighting must be considered where night operations are anticipated.

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(6) Fire protection. While open storage areas are not normally considered as high a risk as conventional warehousing, proper fire protection is still a major consideration.

(7) Outdoor sports and recreation areas. Sports fields and recreation areas requiring hard surfaces will follow the minimum criteria indicated for open storage. Slopes of pavement and lighting of areas will be in keeping with the requirement of the sport involved.